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ANTHROPOMETRIC STATISTICS OF AMHERST COLLEGE.

BY EDWARD HITCHCOCK, M.D.

When the Department of Hygiene and Physical Education was established in Amherst College, about thirty years ago, one of the very first things accomplished was the securing of bodily measurements and tests of every student as he entered the college, and again at intervals. This has been kept up with increasing accuracy and enlargement, and is still an important feature of the department. It has been the habit of the department to furnish at many of the public occasions of the college, along with the schedule of the exercises, some anthropometric and other closely connected statistical details in a printed form.

The first work to be mentioned is the result of five years' record of the measures of all the students of college, in eight items of inquiry, from 1861 to 1865. These averages were:

Age, 21 years and 4 months.		
Weight, without clothes, . . .	137.9	pounds.
Height, ...	67.8	inches.
Chest girth, without clothes, . .	35.3	"
Arm girth, ...	11.3	"
Forearm girth, ...	10.9	"
Capacity of Lungs, ...	237.2	cubic inches.
Measure of strength, ...	11.3	

During the same five years the *sickness of college students* as averaged to each man, and to the four classes, was recorded. In this study each man in college lost 2.34 days of the year from sickness or accident, a man being regarded as "sick" who was absent three or more consecutive days from all college exercises.

The number of individuals who were sick during this period, giving the average of each class, was found to be : —

Seniors,	5.6	men.
Juniors,	7.0	"
Sophomores,	10.8	"
Freshmen,	12.8	"

showing that health increased during the college course.

Some items were gathered in a study of ten years, by classes, with reference to sickness, as before mentioned, and the results were as follows : —

Seniors,	averaging	50.0	men,	had	6.6	on	the	sick	list.
Juniors,	"	53.2	"	"	9.1	"	"	"	"
Sophomores,	"	62.9	"	"	12.6	"	"	"	"
Freshmen,	"	64.1	"	"	14.9	"	"	"	"

And in this same period the average loss of time to each sick man was 11.4 days, and to all the college of 2.1 days. There also were among these men 43 different maladies, of which 33 per cent were colds and 9 per cent physical accidents and injuries.

Still later, statistics of 14 years' duration for 3488 students were compiled, and the following law seemed to be deducible: The rate of difference in numbers between freshmen and sophomores was 6 per cent, and the decrease in sickness 15 per cent. Between the sophomore and junior classes the numerical difference was 14 per cent, and the decrease in sickness 17 per cent. The falling off in numbers from junior to senior years was 8 per cent, and the sickness decreased to the amount of 30 per cent.

A study of the viability of the first 39 classes of the college —1821 to 1860 — on the living condition of these graduates has also been a matter of study. The average viability was 84 per cent, or 16 per cent mortality in classes, averaging at their graduation 24 years of age.

Another study during 1874 was (see *Table A*, p. 590) —

Table A.

Some of the Anatomical and Physiological " Constants " of a student of Amherst College. Determined by 4311 observations recorded during the past thirteen years, with the relative percentage of the different classes, the Freshman as the unit of comparison.

	Age in Years.	Relative per Cent.	Weight in Pounds.	Relative per Cent.	Height in Feet.	Relative per Cent.	Chest Girth in Inches.	Relative per Cent.	Arm Measure in Inches.	Relative per Cent.	Forearm Measure in Inches.	Relative per Cent.	Utmost Lung Capacity in Cubic Inches.	Relative per Cent.	Test of Strength.	Relative per Cent.	Relative Class Percentage.
Seniors.........	22.403	1.164	142.239	1.067	5.681	1.016	35.755	1.014	11.716	1.033	11.141	1.020	259.610	1.093	11.427	1.201	1.076
Juniors.........	21.941	1.140	141.552	1.062	5.682	1.016	36.006	1.022	11.676	1.029	11.060	1.013	254.341	1.071	11.411	1.200	1.069
Sophomores....	20.700	1.075	138.395	1.038	5.663	1.013	36.107	1.025	11.638	1.025	11.062	1.013	256.222	1.099	10.700	1.125	1.051
Freshmen.. ...	19.248	1.000	133.331	1.000	5.590	1.000	35.236	1.000	11.351	1.000	10.920	1.000	237.445	1.000	9.512	1.000	1.000
All.............	21.073	1.095	138.879	1.042	5.654	1.011	35.776	1.015	11.595	1.021	11.045	1.011	251.904	1.061	10.512	1.105	1.049

In 1879 the average and mean measurements of 1262 students, attending between 1861 and 1878, were contrasted in respect to six items. The contrasts are here shown. The average age was 21 years and three months.

	Mean.	Average.
Weight in pounds, ...	127	139
Height in inches, ...	67	66
Chest girth in inches, ...	36	36
Arm " " "	11	12
Lung capacity in cubic inches, ...	220	250
Pull up, number of times, ...	12	11

26,060 measures of 1321 students of the six items below gave strength to the belief that the body gains its physical perfection between 26 and 30 years of age.

It is generally accepted as a law that bodily growth continues until the age of 30. This law, however, is not verified by these statistics when studied by the single years of observation, owing probably to an insufficient number of data, and specially above the age of 24. But on grouping the years thus: All under 20; all from 20 to 24, inclusive; and all from 25 to 29, inclusive, there is a very close illustration of the general law, as is seen by this table.

Age.	Weight.	Height.	Chest Girth.	Arm Girth.	Lung Capacity.	Body Lift.
Under 20	133.50	66.20	34.75	11.33	233.85	9.88
20 to 24	140.28	68.12	36.25	11.78	254.23	10.68
25 to 29	143.40	68.48	36.85	11.69	264.66	10.64

See *Table B* on page 592.

After 20 years of gathering and recording anthropometric statistics of our students several tables were compiled relating to physical measures, growth and development, the sick list, and the maladies. These are here inserted.

See *Table C* on page 593.

Table B.

The average results of the measures of the weight, height, chest, arm, lung capacity, and body lift of 1321 different students of Amherst College during the years 1861–62 to 1877–78, inclusive.

Age in Years.	Number.	Weight in Pounds.	Number.	Height in Inches.	Number.	Chest in Inches.	Number.	Arm in Inches.	Number.	Lung Capacity in Cubic Inches.	Number.	Times Lifted.	Total Numbers.
17	42	131.821	42	66.156	42	33.847	42	11.131	42	220.27	40	8.47	250
18	573	133.250	573	66.596	573	35.019	573	11.353	551	237.31	571	10.35	3,414
19	751	135.440	751	67.068	751	35.397	751	11.514	715	243.96	751	10.83	4,470
20	759	138.106	759	67.800	759	35.723	759	11.584	726	249.52	757	10.54	4,519
21	722	139.529	722	67.716	722	35.748	722	11.828	697	249.93	721	10.73	4,306
22	523	140.852	523	68.148	523	36.109	523	11.819	496	253.65	520	10.98	3,108
23	382	140.680	382	68.260	382	36.330	382	11.901	360	256.83	380	10.73	2,268
24	258	142.249	258	68.676	258	37.365	258	11.794	247	261.22	256	10.44	1,535
25	144	145.029	144	68.832	144	36.025	144	11.777	140	264.15	143	10.01	859
26	106	144.261	106	68.436	106	38.528	106	11.780	96	262.63	104	10.50	624
27	57	143.911	57	68.316	57	36.923	57	11.851	54	266.20	56	10.53	338
28	27	141.129	27	68.664	27	36.374	27	11.574	24	269.79	26	12.31	158
29	19	142.684	19	68.076	19	36.415	19	11.513	19	260.52	15	9.86	110
30	18	146.500	18	69.192	18	36.705	18	11.611	17	279.65	12	7.50	101
	4,381		4,381		4,381		4,381		4,184		4,252		26,060

Table C.— Measures of 2106 different students of Amherst College, showing the Averages of each class for twenty years, in Age, Weight, Height, Chest Girth, Arm Girth, Forearm Girth, Lung Capacity, Body Lift, Finger Reach, Chest Expansion, and the Comparative Right and Left Hand Strength.

	Number Observed.	Age.	Weight.	Height.	Chest Girth.	Arm Girth.	Forearm Girth.	Lung Capacity.	Body Lift.	Finger Reach.	Chest Expansion.	Right Hand Strength.	Left Hand Strength.	Per Cent Strongest with Right Hand.
Seniors.........	1,113	22.24	142.19	67.94	35.97	11.77	11.21	251.05	11.33	69.72	3.18	92.02	86.48	93
Juniors.........	1,148	21.87	140.59	67.86	35.61	11.72	11.07	250.07	11.31	69.78	3.33	88.99	85.98	97
Sophomores....	1,263	20.57	139.39	67.53	35.44	11.69	11.06	249.23	10.58	69.70	3.45	90.45	86.05	96
Freshmen......	1,489	19.31	133.19	67.33	34.76	11.23	10.80	233.08	8.61	69.60	3.00	87.83	83.34	96
College Average	5,013	21.10	138.84	67.66	35.40	11.19	11.02	241.79	10.25	69.69	3.02	89.69	85.50	95
College Mean..	.....	.....	131.00	67.50	35.50	11.25	....	230.00	11.00	.....	.....	.....	.....	....

Table D.— Showing the Maxima and Minima of every measurement of the 2106 students observed.

	Age, Years and Months.	Weight in Pounds.	Height in Inches.	Chest Girth in Inches.	Arm Girth in Inches.	Forearm Girth in Inches.	Lung Capacity in Cubic In.	Body Lift.	Finger Reach in Inches.	Chest Range in Inches.
Maxima......	35.6	216	76.5	43.00	15.5	15.00	426	65	81.10	5.50
Minima.. ..	15.3	84	58.0	27.25	8.0	8.25	115	2	48.00	1.50

Table E — The *Mean Observations* of the measures of Amherst College students for twenty years, from a total of 34,384.

Weight in Pounds.	Number.	Height in Inches.	Number.	Chest Girth in Inches.	Number.	Arm Girth in Inches.	Number.	Lung Capacity in Cubic Inches.	Number.	No. of Times Body Lifted.	Number.
175	69	72	104	40	61	14.0	44	340	53	21	88
167	105	71	291	39	165	13.5	81	320	94	20	176
159	238	70	385	38	394	13.0	323	300	275	18	372
151	490	69	808	37	704	12.5	602	280	608	16	610
143	798	68	955	36	1,079	12.0	1,117	260	871	14	790
135	1,157	67	986	35	1,164	11.5	1,205	240	1,287	12	940
127	1,198	66	790	34	1,098	11.0	1,245	220	1,275	10	1,075
119	982	65	571	33	682	10.5	658	200	732	8	796
111	487	64	371	32	310	10.0	316	180	379	6	590
103	163	63	208	31	104	9.5	77	160	148	4	302
95	46	62	65	30	41	9.0	17	140	39	2	120
	5,733		5,534		5,812		5,685		5,761		5,859

Table F.— Data of Student Sickness and Physical Disability for nineteen years and nine months in Amherst College.

Students' names on the annual Catalogues, 1861 to 1881, inclusive, 5443.

	Names on An'l Catalogues for 20 Years.	Names on Sick List.	Per Cent of Each Class to Whole College.	Per Cent of Sickness in Each Class to Whole College.
Seniors..........	1,192	260	21.90	19.05
Juniors..........	1,270	319	23.33	23.37
Sophomores......	1,465	386	26.92	28.28
Freshmen........	1,516	400	27.85	29.30
	5,443	1,365	100.00	100.00

Students on the sick list, ...	1,375
Cases (not individuals) of sickness, . . .	1,725
Cases on sick list more than once in the year, .	350
Per cent of college on the sick list, . . .	25.26

Table G.— The Maladies of the students, and their proportion, when it equals one or more per cent of the whole. This is the number of *cases*, not students.

Maladies.	Per Cent.	Maladies.	Per Cent.
Colds, Pneumonia, Bronchitis, etc.	37.4	Liver and bilious...........	2.3
Physical injury.....................	8.8	Neuralgia....................	1.8
Febriculœ........................	4.8	Malaria......................	1.7
Eyes, weak and sore...............	4.7	Mumps........................	1.7
Quinsy and sore throat............	4.6	Diphtheritic.................	1.1
Boils.............................	4.1	Measles......................	1.1
General inability.................	3.1	Teeth........................	1.1
Typhoid fever.....................	3.1	Stomach......................	1.1
Bowels............................	2.6	Overwork.....................	1.0

Table H.— The measures of Weight, Height, Chest, Arm Girth, Lung Capacity, and Body Lift of 2106 different students of Amherst College, arranged by age.

Age.	Number of Observations.	Weight.	Height.	Chest.	Arm.	Lung Capacity.	Body Lift.
17	330	131.99	66.60	33.87	11.12	224.8	8.58
18	1,172	134.07	66.96	35.10	11.36	238.7	10.35
19	1,511	135.84	67.30	35.38	11.52	240.3	10.82
20	1,358	138.12	67.95	35.52	11.57	248.8	10.97
21	1,171	140.00	68.01	35.58	11.69	250.1	10.84
22	807	141.07	68.11	35.98	11.77	250.8	10.92
23	559	141.21	68.31	36.29	11.71	257.0	10.63
24	362	142.42	68.44	37.23	11.74	261.0	10.62
25	216	145.12	68.68	36.66	11.79	263.6	10.11
26	141	144.91	68.82	37.46	11.81	262.5	10.71
27	71	144.40	68.30	36.95	11.84	268.4	10.37
28	30	140.71	68.52	36.28	11.57	269.8	8.51
29	19	142.68	68.09	36.41	11.51	260.5	9.86
30	18	146.50	69.19	36.70	11.61	279.5	7.50

Table I.— Giving the measures of 749 students of Amherst College at two intervals of three years and six months, and at an average age of 19 years and two months at the first observation, showing their physical development during this period.

		Per Cent.
Number of *men* measured, ...	749	
“ “ increased in all items, ...	196	26.15
“ “ decreased in some items, . . .	401	53.40
“ “ both same and increased items,	355	47.39
“ “ both same and decreased items,	211	28.17
Number of *items* secured, ...	5,160	
“ “ showing increase, ...	3,972	76.97
“ “ same Freshman and Senior year,	487	9.43
“ “ less in Senior year, ...	701	13.58

	Weight. Pounds.	Height. Inches.	Chest. Inches.	Arm. Inches.	Forearm. Inches.	Lung Capacity. Cubic in.	Body Lift.
Greatest individual gain...	56.00	6.00	6.50	4.000	3.500	1.34	25.00
Averages of increased men	12.27	1.05	1.45	0.853	0.685	28.40	4.50
Per cent of decreased items	11.00	....	20.31	13.460	25.270	14.64	20.13

Some statistics have been gathered showing the differences between the “average” and the “mean.”

Sir John Herschel has said “an average may exist of the most different subjects, as the height of houses in a town, or the size of books in a library. It may be convenient to convey a general notion of things, but it involves no conception of a natural and recognizable central magnitude, all differences from which ought to be regarded as deviations from a standard. The notion of a mean, on the other hand, does imply such a conception standing distinguished from an average by this feature, namely, the regular march of the groups, increasing to a maximum, and then again diminishing. An average gives us no assurance that the future will be like the past; a mean may be reckoned on with the most implicit confidence.”

Table J.— Showing the average and mean measurements, in respect to six items, of 2106 students between 15 years and 3 months and 35 years and 6 months of age, with an average age of 21 years and 1 month.

Weight, . .	138.84 lbs.	=	63.00 k.	131.00 lbs.	=	59.40 k.
Height, . .	67.56 lbs.	=	1.72 m.	67.34 in.	=	1.71 m.
Chest girth, .	35.40 in.	=	89.90 c.m.	35.50 in.	=	90.00 m.
Arm girth, .	11.02 in.	=	27.99 c.m.	11.25 in.	=	28.57 c.m.
Lung capacity,	241.70 cu. in.	=	3960.70 c.c.	230 cu. in.	=	3769.40 c.c.
Body lift, . .	10.25 times.			11 times.		

A study was made showing the relation of the trunk, the arm reach, and the horizontal length of the body.

The results given below (*Table K*) were secured from measurements of 327 students, the whole college numbering 340. The measurements were taken during March and April, 1882, and the average age of all men measured was 21 years and six months.

One of the objects to be gained from this work is to learn the relation between the length of the cerebro-spinal column, the perpendicular height of the body, its length when extended horizontally, and the distance between the tips of the middle fingers when the arms are fully extended.

Medical Director Ruschenberger of the U. S. Army says: "It seems probable that the length of the cerebro-spinal column may be a more valuable element in estimating the physical qualifications of a recruit than total stature. Observation has led me to conjecture that as a rule men of average height, made up of a long trunk and comparatively short lower extremities, possess greater power to endure with impunity great labor and exposure to vicissitudes of all kinds than men who have comparatively long lower limbs and short trunk."

The relative measurements of these portions of body have been made, and the results are seen in the appended table. And these results are given by class averages, and by averages of the aggregate students, which are expressed both in the metric and in the English system.

The finger reach is	1.787	metres, or	70 355	inches.
The horizontal length is . .	1.748	" "	68.820	"
The perpendicular height is .	1.729	" "	68.071	"
The sitting height is . . .	907	millimetres or	35.709	"

We seem, then, to learn from these statistics that a college student, as expressed by an Amherst average, may expect to give a trunk measurement proportioned to his total height of 1.1906. This is a difference of 822 millimetres, or about 32 inches, and the trunk is more than half the total height of the body. The difference in length between the body lying down and the body standing erect is 19 millimetres, or about three-quarters of an inch, in favor of the horizontal measure. The measure of the tips of the fingers exceeds the total height by 39 millimetres, or about one and one-half inches.

Table K.

	Number of Men.	Finger Reach.	Horizontal Length.	Height of Whole Body.	Sitting Height.
Seniors.............	64	1.805	1.776	1.773	910
Juniors.............	95	1.787	1.763	1.739	919
Sophomores........	79	1.779	1.727	1.716	902
Freshmen..........	89	1.777	1.725	1.689	897
Average............	.....	1.787	1.748	1.729	907

See *Table L* on page 598.

Up to nearly this time, 1882, our statistical work had been directed very much to averages, means, development, and growth. But all along the thought had been pressing itself forward that there is some standard by which to estimate the proper growth and development of the student; or at least we must have some method to work by advisedly. It was perhaps well enough for the average, the mean, the 50 per cent man, but what can we do for all the others? The thought of the *Stature or Bodily Height* seemed a desirable field to work in, and accordingly the whole effort was devoted to *arranging all the measurements in groups of heights running one centimetre each.* The first table of this descrip-

Table L.

Measures of the Weight, Height, Chest Girth, Arm Girth, Lung Capacity, and Pull Up of the students of Amherst College, gathered between the academic years of 1861–62 and 1884–85, inclusive, noted in the English and in the *Metric* system. Arranged and averaged by Age, and of 7988 individuals.

Age of the Students.	Number of Students Measured at Each Year.	Weight in Pounds and Decimals.	*Weight in Kilos and Tenths.*	Height in Inches and Hundredths.	*Height in Metres and Millimetres.*	Chest Girth in Inches and Hundredths.	*Chest Girth in Milli-metres.*	Arm Girth in Inches and Hundredths.	*Arm Girth in Milli-metres.*	Lung Capacity in Cubic Inches.	*Lung Capacity in Litres.*	Pull Up. Number of Times.
16	**20**	123.42	*56.1*	66.70	*1.695*	34.20	*868*	10.60	*268*	225.0	*3.68*	8.58
17	**390**	128.73	*58.5*	66.77	*1.697*	34.23	*870*	11.06	*280*	229.9	*3.80*	9.42
18	**1,322**	131.09	*59.6*	66.95	*1.700*	35.42	*895*	11.23	*285*	239.3	*3.97*	10.06
19	**1,452**	133.13	*60.5*	67.12	*1.709*	35.43	*896*	11.40	*290*	244.1	*4.02*	10.18
20	**1,478**	134.99	*61.3*	67.47	*1.714*	35.63	*905*	11.58	*295*	250.4	*4.11*	10.17
21	**1 251**	136.37	*61.9*	67.50	*1.716*	35.92	*918*	11.65	*298*	254.0	*4.18*	10.26
22	**867**	137.61	*62.5*	67.58	*1.720*	36.29	*926*	11.74	*300*	256.9	*4.20*	10.26
23	**589**	138.95	*63.1*	67.70	*1.721*	36.75	*934*	11.94	*303*	260.5	*4.28*	10.26
24	**382**	140.33	*63.8*	67.77	*1.722*	37.36	*940*	11.96	*304*	263.0	*4.30*	10.26
25	**237**	142.34	*64.7*	67.90	*1.726*	37.40	*947*	11.98	*305*	265.0	*4.36*	10.27

tion was made in 1884 from the height of 155 to 183 centimetres of 51 items of measurement from 628 men. Then each man as he was measured, with his record in his own hands, could see his exact relation to the average man of his own height, as determined by the records for many years past.

From this table were constructed cards — one for each centimetre — of the heights already mentioned, and containing the records of the 51 items observed, and side by side of his own record of measures. And upon this same card were given the directions and suggestions of the examiner, when there was a special lack of development, and one with the average of all college for work and development. Besides this it contained the directions for taking the measurements as adopted by the American Association for the Advancement of Physical Education, the method of examining the eyes and ears, and general directions for the use of the development apparatus in the gymnasium.

Two years later another edition of the manual was issued, and today, 1893, a third one is just from the press, with enlarged tables and data, but all tending to confirm the idea that stature is the foundation upon which the idea of the typical student should be constructed, and the source from which all corrections for imperfect or non-development should be made.

It is most interesting to note that the statue of the typical college student exhibited at the Chicago Exposition today most strongly exemplifies this idea.

To conclude, the results of Anthropometry in Amherst College as they stand today are to be found in the tables accompanying this paper, and in the revised tables contained in the third edition of the *Anthropometric Manual of Amherst College, 1893.*